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ABSTRACT

A 1975-77 study examined those characteristics of Australian secondary schools and science teachers associated with the use of innovative curriculum materials developed by the Australian Science Education Project (ASEP). Researchers monitored a national sample of 267 schools on their use of ASEP materials, surveyed 1,699 of the schools' science teachers, and made regular site visits to several schools in the state of Victoria. Survey data were gathered from each school's science department on its organization (or effective use of ASEP materials), cooperation among teachers, openness to innovation, interaction or linkage with external resources, and knowledge of ASEP innovations. Using discriminant and cluster analysis, the researchers studied ASEP users in each state. Further analysis in Victoria, using case studies, identified four groups of ASEP users: (1) above-average users open to innovation, (2) below-average users with little openness to innovation and few external linkages, (3) average users with little openness and few linkages, and (4) below-average users with adequate linkages but low openness to innovation. According to the results, less than half the schools had conditions conducive to ASEP innovations. The researchers suggest that teachers need more links to external resources. (RW)

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USER CHARACTERISTICS ASSOCIATED WITH THE IMPLEMENTATION OF A CURRICULUM INNOVATION - AN AUSTRALIAN EXAMPLE.*

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During the last decade in Australia, many changes have occurred in the structure and administration of schools. Formerly administration and control of most aspects of schooling, including the curriculum had been the responsibility of agencies based at the State level. More recently there have been indications that schools are becoming more autonomous in making decision about all aspects of the curriculum they offer. The move toward school based decision making has been supported at the Federal level, by the newly created Curriculum Development Centre. At the State level, there are now indications that Education Departments and others are setting up support for schools, in the form of teacher centres, inservice activities and consultancy services.

The swing toward school based curriculum development opens up a set of questions which are related to the way new knowledge can be most effectively transmitted and used by teachers who are now, more than ever before, responsible for their own actions. In this paper, the characteristics of teachers which were associated with the use of new knowledge in the form of a major curriculum innovation, the Australian Science Education Projects (ASEP) are discussed.

It is necessary at this stage to outline briefly the history of ASEP to indicate its innovative characteristics, and its importance in the Australian context.

During the period from 1969 to 1974, the ASEP produced materials which were designed to be used in Science classes in secondary schools. The Project was the first major endeavour in curriculum development at the national level in Australia. It was funded by the Commonwealth and all State Governments, the total cost of the Project was A$1.4 million. In all, 47 units were produced by the Project team which were suitable for use with students in the first three or four years of secondary schooling.

Interest in ASEP in Australia by educators and administrators centred on the impact of the Project on teachers and their students. ASEP was a large scale attempt by the developers to influence the content taught in Science, the methods used by teachers, and the organization of the Science curriculum in secondary schools.

ASEP had many innovative characteristics some of which built upon the initiatives of other curriculum projects, particularly those in the United States of America (USA). The Project was based on a framework of traditional curriculum development which included a consideration of aims, selection of content, learning experiences, evaluation and technology. Two underlying main ideas: (i) an environment approach and (ii) the nature of Science were used to plan and write the units. The development team attempted to produce materials which stressed the need for students to understand the physical and biological aspects of the world in which they lived and the roles and limitations of Science in the solution of problems faced by man. (ASEP, A Guide to ASEP, 1974: 87-94).

Many of the units written were cross-disciplinary in content in keeping with the tradition in Australia to teach Science in the junior secondary school as an integrated subject rather than as separate disciplines. In some cases, ASEP attempted to broaden the range of content available to teachers by producing units which used content traditionally taught in the social sciences (e.g. 'Australians Past and Present') and in areas of social concern (e.g. 'Males and Females'). All units were written after the developers took into account Piaget's investigations into the cognitive development of children. This set the level of difficulty of each section or option of each unit.

ASEP encouraged an enquiry approach to teaching and learning Science, an approach which suggested that students should not only carry out investigations but also make decisions about what apparatus they should use and how they should organise their experiments. This meant that

students were required to translate instructions from ASEP texts into action. To facilitate this, extensive research into reading levels of adolescents was made before writing the units at the appropriate levels (Gardner, 1972).

The form of materials encouraged the use of individual student assessment rather than normative measures by including tests which could be used by students at strategic points throughout the units.

Finally, it is important to note the form of the materials. In recognition of the role of teachers in the planning and selection of their Science curriculum the ASEP team did not produce a course, but a set of units, which were largely independent of each other. There were texts for students and a teacher's guide for each unit. This included information which was designed to facilitate matching of learning experiences to the abilities and needs of individual students. There was also information for teachers concerning the reading and intellectual levels of each subsection or option of each unit.

The implementation of ASEP ideas and materials needed to be considered in relation to the ways in which Science had previously been taught in Australian schools. Although there had been some attempts to introduce new forms of teaching and organization in some States (Dale, 1966), it was evident that much Science teaching was didactic in form using a single textbook which was orientated toward the presentation of content matter. (Ramsey, 1972). Thus, the implementation of a Science course based on the ideas or materials of ASEP meant a dramatic restructing of the Science curriculum in many Australian secondary schools.

The ASEP team recognized in its original plans that extensive inservice training was needed to assist in the dissemination of the major ideas underlying the development. However due to a complex set of political and economic factors, ASEP was not able to implement its own program of

re-education, apart from trialling of materials during the formative stages of the Project. It was left to State level authorities to assist teachers in the adoption and use of ASEP ideas and materials. Thus there was a possibility that when the materials became available in 1974, there would be differences in the use of ASEP not only between schools but also between State systems.

In recognition of the need for empirical research on the spread and use of curriculum innovations in Australia, a study was begun in early 1975 at the Australian Council for Educational Research which was concerned with the effects of the ASEP endeavour. The study was completed in 1977 and was guided by the following research questions:

1. To what extent have the ASEP materials been purchased and used by Australian schools, and how has this purchase and use varied over time?
2. Has the extent of use varied from State system to State system? How does the use of ASEP relate to local characteristics and conditions such as outline syllabuses, and locally developed materials?
3. What are the characteristics of a user group which are associated with the incorporation of ASEP ideas and materials into their Science curriculum?

The study was thus concerned with effects based within the school and those at the system level which impinged on the implementation of ASEP. In this paper I will be mainly concerned with user effects.

User Effects

Initially, it was necessary to identify within schools those who were associated with the decision to adopt and implement the Science curriculum in the schools. From studies of decision making about the curriculum in the Australian context (Beeson and Gunstone, 1975: Northfield, 1975) the users were defined to be those teachers who taught

at least one period of Science per week in the first four years of secondary schooling. In general this included the entire group of teachers within the Science department of a school.

The role of the users has long been recognized as vital in educational reform. For example Miles (1964) has stated that: ..."the invention, adaption of educational innovations depends very centrally on the state of immediate social systems - schools and colleges in which they are to become operative" (Miles, 1964:7)

Indeed some claim that the characteristics of the user group are the most important aspect in dealing with educational change. In the summary of research of innovations across the USA conducted by the Rand Corporation, it was concluded that: "An innovation's local institutional setting has the major influence on its prospects for effective implementation.... our statistical analysis and our fieldwork clearly showed that the project outcomes depended more on the characteristics of the project's setting than any other factor." (Berman and McLaughlin, 1976:131)

This study commenced by considering other research in order to identify those characteristics of users which were shown to be associated with successful implementation of innovations. (Owen, 1977). Five characteristics were selected, and these are defined below:

1. Organization; the extent to which resources and facilities made available by the school are effectively used by the Science Department,
2. Co-operation; the extent to which staff of the Science department assist each other in the day to day functioning of the department, and degree to which decisions are made involving the Science department as a whole,
3. Openness; the extent to which the Science department expressed a willingness to find out about new developments, a willingness to be helped and a desire to change,

4. Interaction; the extent to which the Science department is linked to other users, to others with greater knowledge of trends in curriculum development and
5. Knowledge of the innovation; the extent to which the Science department know about the basic characteristics of the ASEP development and its materials.

These five dimensions formed an Innovation Climate of the user group. The object of this part of the larger study was to examine whether there was a link between these Innovation Climate measures and the implementation of ASEP ideas and materials into the Science curricula of schools across the country.

Plans of the Study

To study the implementation of ASEP, information was collected and analysed in two major phases. The first phase involved a large number of schools (267) and was primarily concerned with the identification of school types and the selection of typical schools of each type for further study. Details of these procedures are discussed later in the paper. In the second phase, the schools selected were monitored over time to build up a comprehensive description of the way in which ASEP materials were incorporated in the Science curriculum. The approach to the study of implementation was therefore a process perspective (Fullan and Pomfret, 1977) rather than a congruence perspective. Using the congruence approach the extent of implementation success is judged according to predetermined standards. Employment of the process perspective was justified in this study on the grounds that the use of ASEP by Science departments could legitimately be varied according to the local conditions in the school. Through observations, teacher interviews and inspection of documents such as curriculum statement and tests, it was possible to estimate the extent to which the ideas of ASEP had affected the planning and conduct of Science programs in a range of schools, each with a different Innovation Climate.

The result of this approach was the assemblage of detailed data from over twenty schools from which tentative generalizations were made about extent of implementation and the relationship between implementation and the Innovation Climate in a manner suggested by Wilson (1974) and Stenhouse (1975).

Data Collection

In late 1975, a stratified probability sample of 300 secondary schools in six States and a Territory of Australia was drawn, and by use of survey methods, information was collected from the Science teachers in these schools. A 90 percent response rate was achieved. Information from 267 schools and 1699 teachers of Science across Australia was used in the analysis. This information included the extent of purchase and use of ASEP units and responses to statements which enabled measures of the five dimensions of the Innovation Climate to be made for each school in the sample. This was done by aggregating the results of all Science teachers in each school.

The five scale used to operationalize these dimensions had previously been checked for reliability (Nunnally, 1967), validity and discriminating power (Gardner, 1975) by trialling them on an independent sample of teachers.

Table 1 outlines the characteristics of the scales.

TABLE 1

Statistics Relating to the Perception Scales Used in the ASEP Evaluation (between teachers) [N = 160]

Scale name	Interaction	Organization	Co-operation	Openness	Knowledge
Mean score	27.0	20.4	17.5	14.9	5.5
Standard deviation	5.9	4.7	5.2	3.6	2.2
Reliability (coefficient α)	0.71	0.67	0.79	0.63	0.64
Number of items	7	7	7	7	8

Range and intercorrelation

	Range	Interaction	Organization	Co-operation	Openness	Knowledge
Interaction	8-35	-	0.01	0.09	0.38	0.22
Organization	8-34		-	0.38	0.11	0.04
Co-operation	7-33			-	0.15	0.07
Openness	7-28				-	0.10
Knowledge of ASEP	1-8					-

These scales together with school measures of the purchase and use of ASEP materials were used to determine whether groups of schools with similar responses existed, to describe these groups, and to identify typical schools within these groups. These procedures were effected through cluster analyses and discriminant analyses on data collected from schools in each State. The decision to analyse by State rather than across the nation was based on evidence which showed that there were marked differences between States, not only in the possession and use of ASEP, but also in other factors which affected the organization of schools: historical circumstances shaping each State's Science programs, socio-political factors and the reluctance of teachers to accept innovations which had been developed beyond State boundaries. (Ramsey, 1972).

The educational milieu of each State was an ubiquitous systemic feature affecting innovation. It was reasoned that once the State data had been analysed some between-State comparisons could be made bearing in mind the contextual differences. The approach, though not free of complexities was considered most suitable in the Australian context, where as already mentioned education is constitutionally a State responsibility.

Grouping Patterns in Victoria

In a cluster analysis, the original number of groups is reduced until all elements have been classified into one or the other of two groups. In the program used in this analysis (H - Group) the total within-groups variance is considered at every step and the groups are selected at each step on the basis of total within-groups variance. Terminal groups are chosen when the next reduction in group size is accompanied by a large increase in within-groups variance.

For schools in Victoria, four terminal groups were considered for further examination. One means by which the groups were compared and contrasted was to inspect the mean values of each of the variables which were entered into the H group analysis. These are outlined in Table 2. Using this information and that obtained from a subsequent discriminant analysis, the four clusters were designated and categorized as follows.

TABLE 2

Means of all Variables Entered into the H Group Program [N=43]

	Group				
	One[N=8]	Two[N=5]	Three[N=18]	Four[N=12]	p
Early Use of ASEP[1]	105	-32	03	-88	<.01
Late Use of ASEP[1]	135	-55	07	-58	<.01
Organization	56	103	-57	05	<.01
Cooperation	68	90	-36	-28	<.01
Openness	122	-10	-15	-55	<.01
Interaction	64	-11	-49	25	<.05
Knowledge of ASEP	41	46	50	-124	<.01

1. Measures of 'Early Use' and 'Late Use' of ASEP are compound variables (see Owen, 1977).
2. All variables are standardized. [$\bar{x} = 0$, SD = 1]

Group One Above Average Innovative Users.[N=8]

The schools in this group were characterized by receptivity to innovation indicated by openness to change and their purchase and use of ASEP materials. The school Science departments of these schools were well organized, the staff work together cooperatively and the teachers were strongly involved in professional activities relating to their teaching.

Group Two Low Linkage - Low Users.[N=5]

This group was composed of schools in which there was below average use of the ASEP materials which was associated with a low openness to innovation and few linkages to curriculum resources located outside the school. However, the 'internal' measures of the Science departments in these schools, their structure and group cohesiveness were high. In these schools, the ASEP materials had been incorporated into a Science program where other textual materials were mainly used.

Group Three [N=18] Low Innovative Average Users.

Schools in this group purchased small amounts of ASEP but not sufficient to service the entire curriculum. The staff of these Science departments were not open to change and had few professional contacts with external agencies designed to provide information about developments in Science education. Within the school, the Science departments were poorly organized and there was little cooperation between teachers.

Group Four (N = 12) Dissonant Innovators and Users

This group was characterised by schools which were low in their use of ASEP units over time and had little knowledge of the innovation. Furthermore, the science staff in these school did not express a desire to try new ideas, even though they were moderately well linked to external agencies. Although there were average organizational arrangements in these science departments, there was little collaboration between staff in the day to day activities of the group.

Discussion

As stated previously, the clustering and discriminant analysis were used to select schools for more intensive study. The schools selected were those close to the group centroids of the discriminant analysis. In general two schools in each cluster were subsequently visited at intervals over a period of eighteen months. From an examination of the cluster analysis data and the evidence collected during school visits it was possible to describe the characteristics of implementation of schools in each terminal group. However, in the space available here, only passing comments can be made.

It can be seen that about one fifth of all schools were Above Average Innovation Users. In these schools the majority of the ideas of the ASEP development had been implemented. This had been achieved by a strongly cohesive group effort which commenced with a review of the existing Science program across the school and a decision to update this program. Important factors in these schools were the initiative and organizing ability of the Head of Science, and his direct contacts with the ASEP development in the formative stages of the Project.

In the Low Linkage-Low User schools, ASEP had been introduced and used on a restricted basis rather than across the entire Science curriculum. In these schools the ASEP rationale had been carefully considered by the staff and a decision taken to adopt the material on a 'trials' basis before commiting the Science program to greater use of ASEP units. During the period of the study, further ASEP materials had been purchased. Again the leadership and knowledge of the Head of Science dominated the decision to try the ASEP materials.

The largest group of schools were those in the group described as Low Innovation Average Users. In these schools ASEP units were viewed as just another resource material by the majority of teachers. There was little to indicate that the underlying rationale of the ASEP development had affected the planning of the school Science curriculum. In fact, there were few signs that a four year curriculum had been organized at all, and often teachers tended to work without reference to their colleagues. In these schools, there was instability in the Science department, inefficient use of facilities, high staff turnover, inexperienced teachers and little leadership.

The fourth group, those schools described as Dissonant Innovators and Users used little or no ASEP materials, and few teachers in these schools knew much about the characteristics of the ASEP development. Subject matter was traditional in format and didactic teaching methods were mostly employed. There was often a syllabus rather than a curriculum statement. Teachers in these schools were often committed to writing 'teacher made' sequences rather than considering the use of externally produced curriculum materials in their programs.

Concluding Comments

This paper attempts to illustrate the advantages which occur in studies of this type when a tentative paradym is used to guide the collection of data and analysis. (see Parsons, 1976). The study also attempts to show that multivariate analysis and case-study techniques can be used in a complementary fashion to evaluate the fate of a curriculum innovation.

The identification of groups of schools and the subsequent detailed descriptions of typical examples in Victoria yielded information from which conclusions of a tentative nature could be made about the impact of ASEP in schools across the State. The results suggested that only in a small proportion of schools, less than half, were there a set of conditions in the Science department which were conducive to the implementation of Science programs which were fully or partly based on the ASEP rationale. These conclusions should be of concern for advocates of school level curriculum development which is based on new developments in educational thought.

There is an obvious need for teachers to become more aware of their roles, for stronger curriculum leadership at the school and school department level, and for more mechanisms by which teachers can be linked to external sources of information and advice. There are clear messages here for those working at the system level, such as the employing agencies and professional associations, to assist in these matters.

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